

DISEASES OF THE EXTERNAL EAR CANAL
OF THE DOG

by

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INTRODUCTION

Diseases of the external ear canal of the dog are among the more common diseases encountered by the practicing veterinarian. The therapy for these diseases varies widely according to the response it will give. The choice of drug or drugs to be used in the treatment is usually based on trial and error.

An extensive search of the literature printed in English, German and French was made for information about the etiology and pathology of otitis externa of dogs. Muller and Glass (1) mentioned a few possible causes of this trouble, but no references describing the pathology could be found. In fact, only one article, Schafer (2), discussing the histology of the normal ear canal, was found and this article concerned the human ear. Many references describing treatments for otitis externa were located and will be described later.

This lack of available literature prompted these investigations of otitis externa in an attempt to show some of the etiological factors, pathological changes which occur in the tissues of the external ear canal of the dog, and the treatments which give the most rapid and complete recovery.

MATERIALS AND METHODS

The investigations were made upon dogs as they were presented for treatment for diseases of the external ear at various veterinary hospitals. A number of dogs were purchased by the author to determine the etiology and study the pathological changes which occurred in the tissues of the external ear canal in otitis externa. Other normal and pathological tissues were obtained for study from dogs that died of other causes.

In the attempts to determine the possible causes of otitis externa, only those substances which might be encountered by dogs in normal life were considered. For example, water frequently enters the ear canal of a dog while it is swimming or being bathed. Soap and saponated solution of cresol are usually employed in a dog's bath and may enter the canal. The presence of exudate in the canal, if not removed, might possibly be responsible for the progressive pathological changes which occur in the tissues of a dog's ear canal. With these thoughts in mind, the four above-mentioned substances were selected to be tested as possible causes of otitis externa. They were applied, as nearly as possible, under the same conditions as they would be encountered in normal life. Dogs are frequently bathed every week, especially during the summer, so injections were made at seven-day intervals.

All gross examinations of the ear canal were made with the aid of an electric otoscope. The tissues for microscopic examin-

tions were stained with hematoxylin and eosin.

The age and sex of the animals seemed to have little bearing on the incidence of diseases of the ear canal. The ages of dogs examined varied from six weeks to twelve years.

THE NORMAL EAR CANAL

Gross Anatomy

The ear canal, or external acoustic meatus, of the dog is in the shape of an inverted truncated cone descending antero-ventrad to the level of the external acoustic process of the petrous-temporal bone. At this level it turns mediad to connect with the osseous external acoustic process. It is formed by two cartilages, auricular or conchal, and annular. The latter joins with the cartilaginous external acoustic process, a projection from the osseous one, and is incomplete dorsad, Miller (3). The skin lining the canal is very thin and delicate. It is connected to the cartilages by a thin layer of connective tissue. The proximal termination of the external ear canal is marked by many folds in the conchal cartilage. The term "ear canal" as used in this paper refers only to that portion of the ear distal to the tympanic membrane and proximal to the cartilaginous folds. The normal ear canal should be free from all exudate, and the skin lining it should have a healthy pink color.

Microscopic Anatomy

Histological sections of tissues taken from the normal ear canal show a very thin layer of stratified squamous epithelium with a dense, homogenous connective tissue lying between it

EXPLANATION OF PLATE I

Fig. 1. Cross section through the tissues of the ear canal just ventral to the cartilaginous folds. Tissues taken from cocker spaniel with normal ears.

- A. Epithelium
- B. Connective tissue
- C. Sebaceous glands
- D. Cartilage

Fig. 2. Cross section through the tissues of the ear canal at the right-angle turn. Tissues taken from the same dog as those in Fig. 1.

- A. Epithelium
- B. Connective tissue
- C. Sebaceous glands
- D. Cartilage

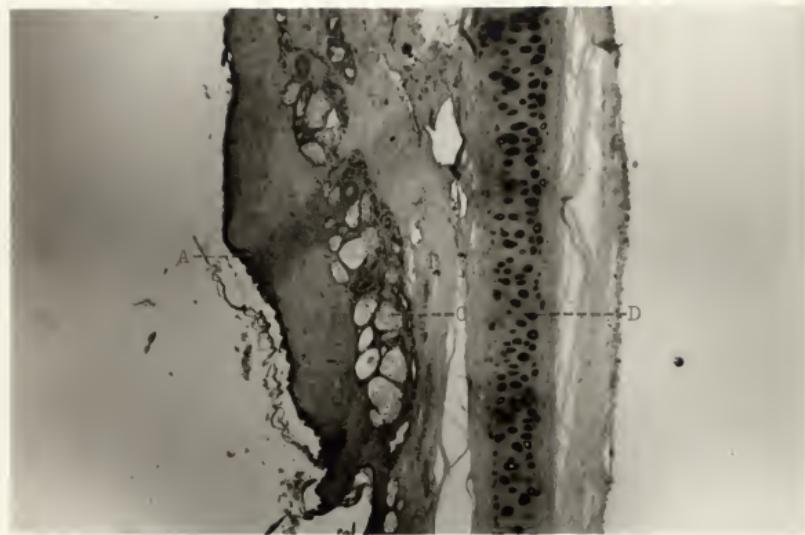


Fig. 1

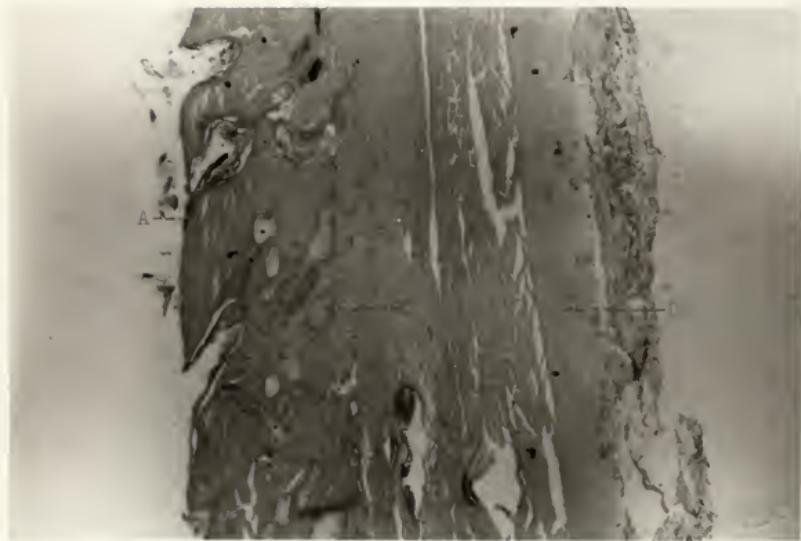


Fig. 2

and the cartilage. A few sebaceous glands are located in the connective tissue just ventral to the cartilaginous folds. These glands increase in number deeper in the canal, becoming most numerous near the tympanic membrane.

THE PATHOLOGICAL EAR CANAL

The amount of pathological change which occurred in the tissues of the ear canal was in direct relationship to the duration of the disease. In order to designate these changes more clearly, instead of using the general term, otitis externa, the following classification was adopted: acute otitis externa, chronic otitis externa, ulcerative otitis externa, suppurative or purulent otitis externa, indurative otitis externa, ceruminous otitis externa and miscellaneous otitis externa, under which were classified parasites, foreign bodies, and neoplasms.

Acute Otitis Externa

Gross Pathology. The skin lining the ear canal was acutely inflamed, characterized by redness and pain, with no evident thickening. A small amount of reddish-brown, homogenous exudate was observed in the canal.

Microscopic Pathology. There was no increase in the thickness of the epithelium. The sebaceous glands in the connective tissue were more numerous.

Chronic Otitis Externa

Gross Pathology. There was evidence of chronic inflamma-

tion, with a slight thickening of the skin. This thickening appeared like numerous, minute papillae extending above the surface. There was a much more copious exudate within the canal.

Microscopic Pathology. The epithelial layer was approximately five times as thick as that from the normal ear. The sebaceous glands were increased both in number and in activity. Ceruminous-like glands, which are modified sweat glands, were visible in the connective tissues taken from the external opening of the ear canal and increased slightly in number deeper in the canal. These glands were of special interest, as they were never apparent in tissues from normal ears, but were consistently found in this type of otitis externa, as well as in the more advanced types. They are probably the result of metaplastic changes. It is probable also that these glands are responsible for the reddish-brown exudate found in all cases of chronic otitis externa.

Ulcerative Otitis Externa

The gross pathological changes were the only ones considered in the investigations of ulcerative otitis. The ulcers were usually located deep in the canal. They appeared as bright red areas of erosion whose margins were inflamed if of short duration or blanched if of long duration. The size of the erosions varied from two millimeters to fifteen millimeters in diameter. Due to the necessity of removing all exudate from the ear canal for a thorough otoscopic examination, the ulcers were usually hemorrhaging slightly. They may have been covered by a scab be-

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fare the canal was cleaned.

Suppurative or Purulent Otitis Externa

Invasions of the ulcerated areas seen in ulcerative otitis externa by pyogenic bacteria caused suppurative otorrhea. Bacteriological examinations of the purulent exudate revealed *staphylococcus aureus* as the causative organism. This exudate was characterized by its foul odor.

Indurative Otitis Externa

The preceding classifications have been discussed in the order of their appearance, depending on the duration of the disease. If no attempt were made to arrest the progress of the disease, they probably would all result in an indurative otitis externa.

Gross Pathology. The skin in advanced indurative otitis externa was extremely hypertrophied. This narrowed the lumen of the ear canal so that many times it was difficult to make a thorough otoscopic examination of the deeper portions of it. The hypertrophied surface was very undulating and covered by numerous papillae. It resembled acanthotic skin in its appearance. The typical reddish-brown exudate was always present. This was abundant in a majority of the cases observed, although a few cases had only a small amount.

Microscopic Pathology. The epithelial layer was from forty to fifty times as thick as that of the normal ear canal. Most of the hypertrophy occurred in the distal two-thirds of the

EXPLANATION OF PLATE II

Fig. 1. Cross section through the tissues of the ear canal just ventral to the cartilaginous folds. Tissues obtained by biopsy from a wire-hair fox terrier with indurative otitis externa.

- A. Epithelium
- B. Connective tissue
- C. Sebaceous glands
- D. Ceruminous-like glands with exudate in the lumen

Fig. 2. Cross section through the tissues of the ear canal just ventral to the cartilaginous folds. Tissues obtained from a springer spaniel with indurative otitis externa.

- A. Epithelium
- B. Keratinized hair follicles
- C. Connective tissue
- D. Sebaceous glands
- E. Ceruminous-like glands with exudate in the lumen



Fig. 1



Fig. 2

EXPLANATION OF PLATE III

Fig. 1. Cross section through the tissues of the ear canal at the turn. Tissues from a cocker spaniel with normal ears.

- A. Epithelium
- B. Connective tissue
- C. Sebaceous glands
- D. Cartilage

Fig. 2. Cross section through the tissues of the ear canal at the turn. Tissues taken from a springer spaniel with indurative otitis externa.

- A. Thickened and keratinized epithelium
- B. Connective tissue
- C. Sebaceous glands
- D. Ceruminous-like glands with exudate in the lumen
- E. Cartilage



Fig. 1



Fig. 2

canal. Numerous epithelial papillae extended deeply into the connective tissue, with sebaceous glands located between them. The ceruminous-like glands were larger and more numerous than those found in chronic otorrhea. Immediately proximal to the cartilaginous folds, extreme keratinization of the hair follicles had occurred. These appeared to be constructed of concentric laminae.

Examination of the tissues at the turn in the canal showed less hypertrophy of the epithelium than was present in the distal portions. The epithelium varied from five to twenty times the thickness of that found in sections of normal tissue from the same location. The skin showed some keratinization, but there was an absence of hair follicles.

Sebaceous glands were slightly more numerous than those of the normal ear but were not as prevalent as in the distal portions of the canal. A few of the ceruminous-like glands were also visible in these sections.

Ceruminous Otitis Externa

The incidence of the disease classified by Milks et al. (4) as ceruminous otorrhea in dogs is small, and it was not produced experimentally. Therefore, a complete study of this disease has not been made. The ten cases investigated were privately owned dogs whose owners would not consent to biopsies for a study of the microscopic pathology.

The most obvious lesion was an acute inflammation of the skin lining the canal. An extremely abundant exudate, light

yellow in color and creamy in texture, with a very foul odor, was present in all cases. This exudate closely resembled that which is secreted by the ceruminous glands and normally found in the human ear. The appearance of this gland, according to Schafer (2) and Bremer (5), is a coiled tubule very similar to the sweat gland but with a larger lumen. It would be extremely interesting to make microscopic studies of tissues from dogs afflicted with this type of otitis externa. My belief is that large numbers of a different type gland would be present, which are responsible for the difference in the exudate.

Miscellaneous Otitis Externa

Parasitic Otitis Externa. The gross tissue changes observed in parasitic otitis externa varied from an acute inflammation to a chronic inflammation with slight induration, depending on the duration of the infestation. The exudate was dark brown and flaky instead of the reddish-brown, homogenous exudate observed in the non-parasitic otitis cases.

Foreign Bodies. Foreign bodies in the ear canal caused an acute localized inflammation around the irritating object. The foreign body could be observed with an otoscope.

Neoplasms. Two types of neoplasms were seen during the investigations, papillomas, which occurred in dogs past five years of age, and epitheliomas, which were seen in dogs as young as two years. The papillomas were generally multilobular, with a narrow peduncle, and benign in character. These were located at the entrance to the ear canal and many times involved the can-

tilagenuous folds.

The epitheliomas were found deep in the canal near the turn and extended to the tympanic membrane. Due to the narrowing of the lumen of the canal, they could easily be diagnosed incorrectly as an indurative otitis externa. This happened in one case, and the correct diagnosis was not made until surgical drainage of the ear canal was performed. Four of the five encountered in these studies were malignant and secondary to a similar neoplasm located elsewhere on the head.

DETERMINATION OF CAUSATIVE SUBSTANCES

The substances selected to be tested as possible causes of otitis externa were limited to those that a dog might contact in normal life. Two dogs with normal ear canals were used for each substance to be tested. The left ear canal of each dog was used as a control, while the tests were made on the right ear canal. A total of eight dogs was used in the experiment, with four test substances: Sterile water, cottonseed oil soap, one per cent saponated cresol solution, and the exudate from the ear canal of a dog with chronic otitis externa. Applications of the first three were made into the ear canal once a week, after an examination of the canal had been made. These experiments were conducted over a twelve-week period. Three weekly applications of the chronic otitis exudate were made, and observations were continued for the remaining nine weeks of the experiment.

Dog #1 was a mongrel poodle, while the other seven were of mixed breeds, predominately of the spaniel type. These animals

were selected because diseases of the external ear canal are most often seen in lop-eared dogs.

Sterile Water

One-half cc. of sterile water was injected with a sterile syringe and blunt, two-inch needle deep into the right ear canal of Dogs #1 and #2 at seven-day intervals. No attempt was made to prevent escape of the liquid when the dogs shook their heads. The dogs showed considerable annoyance immediately after each injection, as evidenced by violent shaking of the head. This symptom abated after five minutes. Examinations of both ear canals of each dog were made with an otoscope each week previous to making the injections.

Dog #1. Mongrel poodle, female, age four years. Both canals remained normal until one week following the third injection. The right ear canal contained a small amount of reddish-brown exudate, and the dog would shake its head and scratch at the ear occasionally during the week. The amount of exudate did not increase noticeably in quantity until after the seventh injection. At this time, there was a marked increase in the amount of exudate, which continued to increase with each subsequent injection. The head shaking and scratching at the ear increased in frequency until the twelfth week. At this time the discomfort was so great that euthanasia was performed. After euthanasia, the exudate was removed with cotton-tipped applicators in order to observe the gross pathology. This observation revealed a

chronic otitis externa with a slight thickening of the skin. The left ear canal remained free from exudate and inflammatory changes throughout the test.

Dog #2. Mongrel spaniel, male, age two years. Both ear canals remained normal until after the sixth injection. The dog complained when the otoscope was inserted into the right canal. The skin was inflamed, and a small quantity of reddish-brown exudate was observed. The left ear canal was normal. These symptoms increased gradually, with considerable head-shaking, until after the tenth injection. The eleventh otoscopic examination caused the dog intense pain. This was due to an ulceration of the skin on the medial surface of the canal midway between the external opening and the turn. There was an increase in the amount of exudate. Euthanasia was performed on the twelfth week, and the canal was cleaned. There was more exudate than was found on previous examinations but not as much as was present in Dog #1. Lesions of a chronic otitis externa with an ulcer four millimeters in diameter were observed. The ulcer had doubled in size from the previous week. The left ear remained free from inflammation and exudate throughout the test.

Cottonseed Oil Soap

One-half cc. of cottonseed oil soap was injected deep into the right ear canal of Dogs #3 and #4 at seven-day intervals. No attempt was made to prevent escape of the soap when the dogs shook their heads. Both dogs shook their heads violently for about five minutes after each injection. Both ear canals of each

dog were examined with an otoscope each week before making the injections.

Dog #3. Mongrel spaniel, male, age three years. The skin lining the right ear canal was more reddened than normal at the second examination, one week after the first injection. The left ear canal was normal. A small amount of reddish-brown exudate was present at the third examination. The skin color had returned to normal. There was little change in appearance of the skin or amount of exudate at the fourth and fifth examinations. The amount of exudate had increased by the sixth examination. The dog was scratching at the ear occasionally and frequently shook its head. The amount of exudate increased slightly with each subsequent injection, until euthanasia was performed after the twelfth examination. From the sixth to the twelfth examinations, the skin slowly changed from an acute to a chronic inflammation, with more thickening than was observed in Dogs #1 and #2. The dog was constantly annoyed by the inflammation, as was shown by the increased frequency of head-shaking and scratching at the ear. The left ear canal remained normal throughout the test.

Dog #4. Mongrel spaniel, male, age two years. No obvious change was noticed in the right ear canal until the third examination. At that time, there was a small amount of exudate deep in the canal, and the skin was slightly inflamed. The fourth examination showed a little more exudate but less reddening of the skin. There was little further change noted until the

seventh examination, when the amount of exudate had increased and thickening of the skin had started. The dog was showing annoyance by intermittent shaking of the head. The amount of exudate increased slowly with each subsequent injection. The dog began to scratch at the ear following the ninth injection. Euthanasia was performed at the twelfth week, and the canal was cleaned and examined. The skin had undergone considerable thickening and was classified as an early stage of indurative otitis externa. The left ear canal was free from exudate and inflammation at all examinations.

Saponated Solution of Cresol

One-half cc. of a one per cent solution of saponated cresol was injected deep into the right ear canal of Dogs #5 and #6 at seven-day intervals. No attempt was made to prevent the escape of the solution after the injections. Both dogs shook their heads violently for about five minutes following each injection. Both ear canals of each dog were examined before each injection.

Dog #5. Mongrel spaniel, male, age five years. The second examination (one week after the first injection) of the right ear canal caused the dog intense pain. There was more inflammation of skin than had been observed in any of the previously examined test dogs. No exudate was present. A moist, colorless, exudate was seen at the third examination. The amount of inflammation was about the same as observed the previous week. The fourth examination showed less exudate and less inflammation than previously observed. A reddish-brown exudate and more inflammation

than had been seen before with this dog was noticed at the fifth examination. The skin of the canal looked to be edematous. There was little change to be noted at the following examination. At the seventh examination, the skin was very inflamed and tender, with a small ulcer on the medial surface of the canal. The amount of exudate was the same as had been seen the previous week. At the eighth examination, few changes could be noted, except that a scab covered the ulcer. The examinations on the ninth, tenth and eleventh weeks showed a marked increase in the thickness of the skin and enlargement of the ulcer, which was hemorrhaging slightly. Euthanasia was performed at the twelfth week and the canal cleaned and examined. The gross pathological lesions showed an indurative otitis externa with an ulceration. The ulcer was six millimeters in diameter. The left ear canal was normal throughout the test.

Dog #6. Mongrel spaniel, female, age four years. The right ear canal was inflamed one week after the first injection but was not tender. However, the examination following the second injection was painful, and there was more inflammation of the skin. A small amount of serous exudate was present. The tenderness, inflammation, and amount of exudate increased slightly with each weekly injection until after the sixth week, at which time the skin was noticeably thickened, and a reddish-brown exudate was observed. The acute inflammation had subsided slightly. Little change was noted at the eighth examination. Intense pain was shown by the dog at the ninth examination. This was due to a small ulcer located on the antero-medial surface of the distal

third of the canal. An increase in the amount of exudate was noted. The size of the ulcer and the amount of exudate increased slowly after each subsequent injection, until euthanasia was performed at the twelfth week. The dog showed evidence of pain from the second week, and it increased in severity as the test progressed. Head-shaking and scratching at the ear was noticeable from the third week. The examination after euthanasia and cleansing of the canal showed an indurative otitis externa with ulceration. The ulcer was five millimeters in diameter. No changes occurred in the left ear canal during the test.

Chronic Otitis Externa Exudate

An application of 100 milligrams of the exudate removed from the ear canals of four clinical cases of chronic otitis externa was made on the skin of the right ear canal of Dogs #7 and #8. Three applications at seven-day intervals were made on each dog. No further applications of the exudate were necessary, because sufficient exudate was being produced by the test dogs after three applications. Otoscopic examinations were made of both ear canals of each dog before each application of the exudate and on each subsequent week throughout the test.

Dog #7. Mongrel spaniel, female, age three years. The right ear canal, at the second examination, showed a slight increase in the amount of exudate. There was a marked increase in the amount of exudate at the third examination, with an inflammatory swelling of the skin. The dog showed some discomfort at the fourth examination. This was attributed to a small

ulcer located on the lateral surface of the canal midway between the external opening and the turn. Much of the swelling, except that around the margin of the ulcer, had disappeared. The fifth examination revealed little change except a slight hemorrhage from the ulcer. A purulent discharge was found at the sixth examination. This increased so much during the following week that it was necessary to remove it with dry, cotton-tipped applicators before the seventh examination could be made. Bacteriological examination of the exudate proved staphylococcus aureus to be the causative organism. The ulcer was twice as large as it had been the previous week. Following this examination, an application of a five per cent sulfathiazole ointment was used to control the infection. This medication was repeated on the next two days. The eighth examination revealed a small quantity of reddish-brown exudate, with no noticeable enlargement of the ulcer. From the ninth week until euthanasia was performed at the twelfth week, there was a gradual increase in the amount of exudate but no apparent enlargement of the ulcer. The examination after euthanasia revealed a chronic otitis externa, with a very slight thickening of the skin. The ulcer was six millimeters in diameter. There were no changes from the normal occurring in the left ear canal during the test.

Dog #6. Mongrel spaniel, male, age three years. There was a slight increase in the amount of exudate present in the right ear canal one week following the first application, and a further increase was noticed at the third examination. A marked increase in the amount of exudate was seen at the fifth and sixth examina-

tions. The acute inflammation had subsided by the sixth week. There was little noticeable increase in exudate at the seventh examination, but the skin had become slightly thickened. The dog was observed to shake his head and scratch at the ear frequently during the seventh week, the amount of exudate, skin thickness, and symptoms of irritation to the dog increased slowly each week, until the test was concluded, at the twelfth week. After euthanasia, the ear canal was cleaned and examined. The changes were classified as an indurative otitis externa. The left ear canal remained normal throughout the test.

Other Causative Agents

The presence of ear mites (*Otodectes cynotis*), ticks, fleas, awns of barley, rye and other plants has long been recognized as a cause of otitis externa. Therefore, no attempt was made to induce inflammatory changes of the external ear canal by them in these investigations.

SYMPTOMS

The general symptoms of otitis externa were head-shaking and scratching at the ear with a foot. If only one ear was affected, the animal would rotate its head so that the affected ear was lower than the normal ear. However, the majority of clinical cases showed bilateral involvement. The frequency with which these symptoms were shown varied with the type of otitis externa from which the dog was suffering, as well as with the nervous temperament of the individual. The symptom of pain, as

evidenced by the animal's crying out when the ear was touched, was rarely observed except in cases of ulcerative otitis externa and suppurative otitis externa.

Disturbance of equilibrium was seen in three dogs, and all were suffering from a parasitic otitis externa. The equilibrium returned to normal within four days after treatment was started.

The outstanding symptom of ceruminous otitis externa was the obnoxious odor which emanated from the dog's ear canal. As much as one-half ounce of the light yellow, creamy exudate was secreted in one week.

The symptoms of purulent otitis externa were the annoyance to the dog and the foul odor which emanated from the ear canal.

Invasion of the ear canal by ticks, fleas and awns caused sudden and very acute irritation to the dog, accompanied by frantic efforts to dislodge the offending object.

Occasionally, convulsions are attributed to diseases, usually of the parasitic type, of the canal. Chronic wounds posterior to the ear, and conchal hematomas are considered symptoms of trouble within the canal, although they are not frequently encountered.

Deafness can sometimes be attributed to otitis externa. An accumulation of exudate within the canal or extreme hypertrophy of the skin lining may reduce the acuteness of hearing or completely obliterate this sense.

TREATMENT

The treatment of otitis externa varies with the type of

inflammation which is present in the ear canal. Therefore, it is necessary to examine the external ear canal thoroughly with an otoscope to make a classification as described previously. If any exudate is present, it should be removed to enable the veterinarian to observe the skin lining the canal. Some of the dogs examined during these investigations objected to the examination. The application of a few drops of a good topical anesthetic, such as two per cent butyn sulfate solution or two per cent pontocaine solution, removed all objection on the part of the dog and won the good will of the owner. Furthermore, it made future examinations much easier.

The choice of drugs used to treat the various types of otitis externa has been made according to their actions on similar changes in the skin of other parts of the body.

Acute Otitis Externa

The classification of acute otitis externa was made in only nine of the clinical cases examined. These included four with foreign objects in the canal. The reason for this low number was the failure of the owner to observe the discomfort of the dog until the disease had advanced to the chronic stage or beyond. The treatment for these cases consisted of removal of all exudate, or the removal of the foreign object. The exudate was removed with dry cotton which was loosely wound on applicator sticks. The foreign objects were removed by alligator forceps which were passed through the cone of the otoscope. A mild protectant ointment, such as 20 per cent zinc oxide in

petrolatum, or 10 per cent zinc oxide and 10 per cent bismuth subnitrate in glycerin, was then applied to the ear canal. The maximum number of treatments necessary for complete recovery was two.

Chronic Otitis Externa

The majority of cases observed were classified as chronic otitis externa. There were 62 cases in this group, with bilateral involvement in 58 of them. Mild stimulation of the epithelium was necessary to give the most prompt results. This was accomplished by adding five per cent resorcin or two per cent oil of cade to the protectant ointments described under acute otitis externa. Before the ointment was applied, the canal was cleaned with dry, cotton-tipped applicators and examined with an otoscope for ulcerations. The number of days between treatments averaged five. Daily treatments caused more irritation and were considered detrimental. The average number of treatments necessary to cure this disease was four, spaced at five-day intervals.

Ulcerative Otitis Externa

Ulcerative otitis externa has been classified separately throughout these investigations primarily for its treatment. Ulcerations of the skin lining the canal were observed in 29 cases of chronic otitis externa and 17 cases of indurated otitis externa. Suspicion of ulceration was aroused by the evidence of severe pain when an attempt was made to clean the ear canal.

The application of a topical anesthetic was necessary to facilitate a thorough cleansing, examination and treatment of the canal. Frequently, blood was seen on the cotton used to clean the canal. Otoscopic examination was made to determine the location and extent of the ulceration.

The most satisfactory treatment was an application of 10 per cent silver nitrate solution twice a week, followed by protectant ointments. Usually two applications of the silver nitrate solution were sufficient if followed by the treatment described under chronic otitis externa for two or three more weeks. The use of a three to five per cent solution of silver nitrate was recommended by French (6).

Suppurative Otitis Externa

The frequent reference to infection by Muller and Glass (1), Milks et al. (4), French (6), and Brumley (7) and their recommended treatments for catarrhal otorrhea apparently pertain to the disease classified as purulent otitis externa in these investigations. These authors recommended removal of the purulent material by irrigation of the ear canal with mild antiseptic solutions, followed by the application of antiseptic and astringent powders and astringent solutions.

Invasion of ulcers by *staphylococcus aureus* occurred in nine of the cases observed. All of these responded promptly to the following treatments after the purulent material was removed with dry cotton: five per cent sulfathiazole in petrolatum; five per cent sulfathiazole in liquid petrolatum; or sulfathiazole pow-

der. The powder was difficult to apply deeply into the canal, and its use was limited to four cases. Treatment was administered daily until suppuration ceased. The maximum number of treatments with sulfathiazole was five, with an average of only two applications of this drug being necessary to overcome the infection. After the suppuration ceased, treatment was continued as described for chronic otitis externa. Cautery of the ulcerated areas was not necessary, since enough irritation was caused by the bacterial invasion to stimulate healing of the ulcer.

Indurative Otitis Externa

The degree of successful response to the medicinal treatment of indurative otitis externa was dependent on the amount of induration which had occurred within the ear canal, as well as on the cooperation of the owner. Twenty-three cases of this type of otitis externa were observed, all of which were bilaterally involved. Thirteen of them were cured, or improved enough so that the animal was made comfortable by medicinal treatments.

Strong stimulation was necessary to reduce the thickening of the epithelium. This was accomplished by the use of a 10 per cent solution of silver nitrate twice a week for two or three weeks, combined with the use of the milder stimulating ointments previously described. The most successful treatment proved to be a daily application of the ointment for the first week, reduced to three applications during the second week, two applications during the third week, and one application a week there-

after, until recovery occurred. Since the treatment of this disease was likely to be lengthy, a full explanation of the disease and its treatment was made to the owner, with an alternative suggestion of surgical drainage of the canal. By this means, the full cooperation of the owner was insured. Two cases in which the epithelial hypertrophy had occluded the external meatus and impaired hearing required treatment for four months. The owner of one of these dogs objected to surgery, and the other dog was 12 years old and was considered a poor surgical risk. It was necessary to use a three per cent salicylic acid ointment for two weeks in each of these cases.

Surgical drainage of the ear canal as described by Schnelle (8) and Northrup (9) was advised in all cases where the indurated tissues occluded the meatus or where there was a history of frequent recurrence of the disease. Unilateral surgery was performed on four dogs and bilateral surgery on six. Other than the usual post-operative care, none of these cases required further treatment of the operated ear canal.

Two cases of acanthosis, a hypertrophy of the basal cell layer of the skin of the concha were observed in these investigations and are mentioned here for their similarity in gross appearance to the indurated skin lining the canal. However, neither of them involved the canal, since the hypertrophy stopped at the cartilaginous folds. They both responded satisfactorily to semi-weekly applications of Whitefield's ointment for five weeks.

The question arose as to what effect treatment and recovery

EXPLANATION OF PLATE IV

Fig. 1. Cross section through the tissues of the ear canal just ventral to the cartilaginous folds. Tissues obtained during surgical drainage of right ear canal of a cocker spaniel with chronic otitis externa. This case was responding satisfactorily to medicinal therapy, but the owner requested surgery.

- A. Epithelium
- B. Connective tissue
- C. Sebaceous glands
- D. Ceruminous-like glands
- E. Cartilage

Fig. 2. Cross section through the tissues of the ear canal just ventral to the cartilaginous folds. Tissues obtained by biopsy from the right ear canal of an English setter after recovery from indurative otitis externa. Surgical drainage had been performed on this ear canal.

- A. Epithelium
- B. Connective tissue
- C. Sebaceous gland
- D. Unidentified tubular gland (probably ceruminous-like glands which have undergone retrogression)

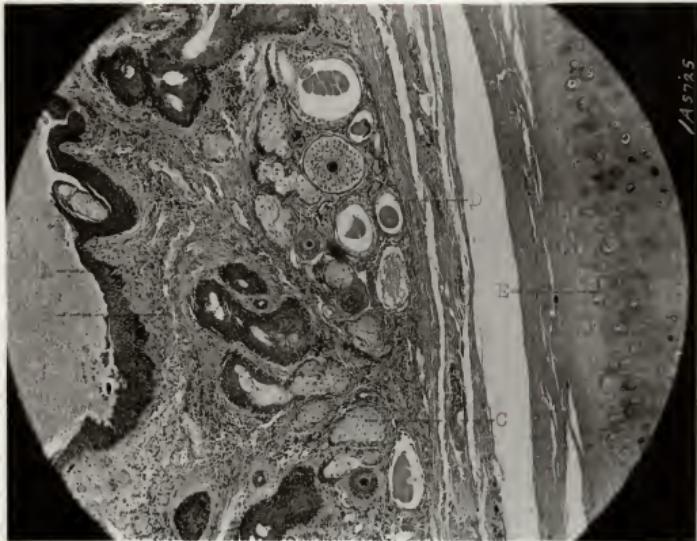


Fig. 1



Fig. 2

EXPLANATION OF PLATE V

Fig. 1. Cross section through the tissues of the ear canal just ventral to the cartilaginous folds. Tissues obtained by biopsy from the left ear canal of the dog described in Plate IV, Fig. 2 after recovery from indurative otitis externa. Only medicinal therapy was used in this canal.

- A. Epithelium
- B. Connective tissue
- C. Sebaceous glands
- D. Unidentified tubular glands

Fig. 2. Cross section through the tissues of the ear canal just ventral to the cartilaginous folds. Tissues obtained during surgical drainage of left ear canal of the dog described in Plate IV, Fig. 1.

- A. Epithelium
- B. Connective tissue
- C. Sebaceous glands
- D. Ceruminous-like glands with exudate but undergoing retrogression
- E. Portion of unidentified tubular gland



Fig. 1

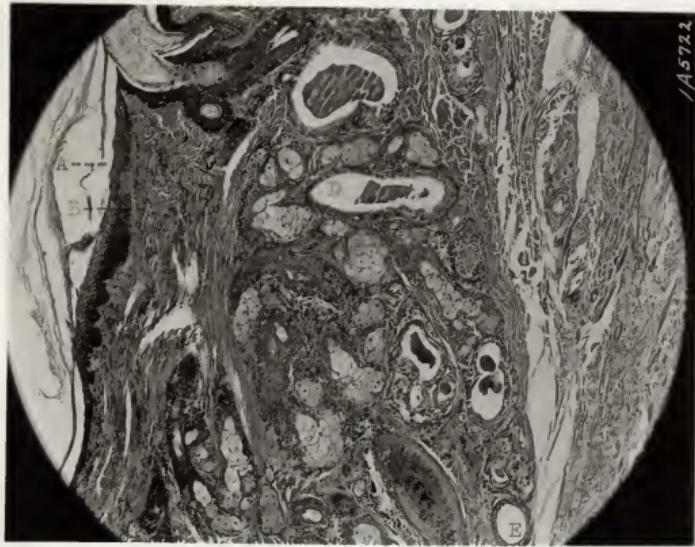


Fig. 2

had on the ceruminous-like glands which were found only in pathological tissues taken from the ear canal. A biopsy was obtained from each ear canal of a dog during bilateral surgical drainage which was performed at the owner's insistence. This dog had been treated for one week for chronic otitis externa and was responding very satisfactorily to medicinal treatment. Another bilateral biopsy was performed on a dog seven months after recovery from an indurative otitis externa which involved both ear canals. Surgical drainage had been performed on one canal, while the other had received medicinal treatment.

A retrogression of the glands was occurring in the first dog, as evidenced by the change in the epithelium of the tubules and the lack of exudate in some of them. The retrogression was more complete in the tissues removed from the second dog, with no exudate evident in the lumen of the tubules and all of them having undergone a change in the epithelium, Plates IV and V.

Ceruminous Otitis Externa

This disease was the most difficult to treat of all the types of otitis externa. Milks et al. (4) recommended a thorough cleaning of the ear canal, followed by drugs, such as salicylic acid, resarcinal, tannic acid, alum and others, which lessen the secretions from the skin. While working under Dr. Milks and Dr. Stephenson in the small animal clinic of the New York State Veterinary College, the author first used aluminum chloride solutions at their suggestion. Various strengths of solutions

of this drug were used, ranging from 10 per cent to 35 per cent. Daily applications of these solutions produced considerable inflammation of the canal.

The most satisfactory results in the treatment of this disease were obtained with a thorough daily removal of all exudate, followed by an application of 20 per cent zinc oxide in petrolatum, with an application of a 20 per cent solution of aluminum chloride twice a week. Six weeks of treatment were necessary to cure this type of otitis externa.

Miscellaneous Otitis Externa

Parasitic Otitis Externa. The drugs recommended for the treatment of this disease by the various authors already cited are extremely numerous. Some of them are as follows: sulfur ointment; 10 per cent tincture of iodine in glycerine; one per cent phenol in linseed oil; eight parts of carbon tetrachloride and three parts of castor oil; equal parts of balsam of peru and glycerine; 10 per cent of caraway in olive oil; one part mercuric nitrate ointment and four parts olive oil; equal parts of balsam of peru, alcohol, ether and glycerine; five per cent phenol in glycerine; and many others. The use of oily bases was advocated for softening the exudate and bringing the parasiticides in closer contact with the parasites, with possible additional value of impairing their respiration.

Thirty-nine cases of parasitic otitis externa were observed in these investigations. Two preparations were used in the treatment of them, with no difference being noted in their

efficiency. They were one part of mercuric nitrate ointment in three parts of neatsfoot oil, and equal parts of carbon tetrachloride in olive oil. One treatment a week for three weeks was routinely practiced, with the exception of three dogs which showed a disturbance in equilibrium. These cases were treated daily for the first week, followed by one treatment a week for the next two weeks. Their equilibrium returned to normal within four days after the treatments were started.

Neoplasms. Surgical removal of papillomas by cautery was recommended by Hobday (10). Six cases of papillomas were treated successfully by the use of electrocautery. Four of these cases had bilateral involvement, and two were unilateral. Post operative care consisted of the application of butesin picrate ointment for two days, followed by sulfathiazole powder until healing was complete.

Three cases of epithelioma were treated during these investigations. The neoplasms were located near the tympanic membrane in two of these cases, with one dog having bilateral involvement. This dog had had an extensive epithelioma removed from the mouth six months previously. The neoplasm in the third case was located just ventral to the cartilaginous folds.

The treatment of all of these cases was the same. It consisted of surgical drainage of the ear canal, followed by removal of the neoplasms by electrocautery. Post operative treatment was daily application of butesin picrate ointment for four days, followed by sulfathiazole powder until healing was complete.

CONCLUSIONS

These conclusions were based on the examination and treatment of 207 clinical cases of otitis externa, applying the knowledge derived from the gross and microscopic studies of tissues removed from five dogs with normal external ear canals and 27 experimental animals which had various types of otitis externa.

1. The normal external ear canal of the dog should be free from exudate and inflammation.
2. Sebaceous glands are the only type of gland visible in histological sections of tissues of the normal ear canal.
3. The pathological changes which take place in the tissues are directly related to the duration of the disease.
4. Ceruminous-like glands become visible in sections of tissues taken from pathological ear canals. Further studies should be conducted to determine if they are the source of the exudate present in all cases of otitis externa.
5. The epithelium undergoes hypertrophy and keratinization as the disease progresses.
6. Further studies should be conducted to determine the cause of ceruminous otitis externa and the tissue changes which occur with it.
7. Caution should be observed while bathing dogs to prevent the entrance of water, soap and saponated cresol solution into the external ear canal.

8. The exudate which occurs in all cases of otitis externa should be completely removed from the ear canal to prevent advancement of the disease.

9. Further studies should be conducted to determine if this exudate causes irritation by physio-chemical changes or by bacterial action.

10. Invasion of the external ear canal by otodectes cynotis was capable of causing disturbances of equilibrium.

11. The most prompt response to treatment of otitis externa was dependent upon a thorough examination of the external ear canal and a proper classification of the disease.

12. Stimulation by irritants such as resorcin, oil of cade, silver nitrate solutions and salicylic acid were essential to promote healing when hypertrophy of the epithelium occurred.

13. Ulceration of the epithelium was common in chronic and indurative otitis externa.

14. Cauterization of the ulcers with silver nitrate solution resulted in prompt healing of the ulcers.

15. Staphylococcus aureus was a common invader of ulcerated areas of the external ear canal.

16. Sulfathiazole preparations were specific for suppurative otitis externa.

17. Prolonged treatment and strong stimulation were essential to cure indurative otitis externa.

18. Surgical drainage of the external ear canal gave the most rapid and complete recovery from indurative otitis externa.

19. A 20 per cent solution of aluminum chloride combined

with a protectant ointment was the most satisfactory treatment for ceruminous otitis externa.

20. Any recognized parasiticide was suitable for the treatment of parasitic otitis externa.

21. Papillomas and epitheliomas occur in the external ear canal, and surgical removal was the only satisfactory treatment.

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ABSTRACT OF MASTERS THESIS

DISEASES OF THE EXTERNAL EAR CANAL OF THE DOG

by

Ralph Edward Witter

The lack of available literature prompted these investigations of otitis externa in the dog in an attempt to show some of the etiological factors, pathological changes which occur in the tissues of the external ear canal, and the treatments which give the most rapid and complete recovery.

Gross and microscopic studies were made of tissues removed from five dogs with normal external ear canals and 27 experimental animals which had various types of otitis externa. These were classified as Acute Otitis Externa, Chronic Otitis Externa, Ulcerative Otitis Externa, Suppurative or Purulent Otitis Externa, Indurative Otitis Externa, Ceruminous Otitis Externa and Miscellaneous Otitis Externa, under which were classified parasites, foreign bodies and neoplasms. These classifications were applied in the examination and treatment of 207 clinical cases of otitis externa.

These investigations led to the following conclusions:

1. The normal external ear canal of the dog should be free from exudate and inflammation.
2. Sebaceous glands are the only type of gland visible in histological sections of tissues of the normal ear canal.
3. The pathological changes which take place in the tissues are directly related to the duration of the disease.
4. Ceruminous-like glands become visible in sections of tissues taken from pathological ear canals. Further studies should

be conducted to determine if they are the source of the exudate present in all cases of otitis externa.

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